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CRYSTALLOGRAPHIC NOTES ON GLAUCOCHROITE, WILLEMITE, CELESTITE, AND CALCITE FROM FRANKLIN, NEW JERSEY

By Samuel G. Gordon.

On a recent trip to the famous zinc mines at Franklin, N. J. the writer secured a series of specimens for the Vaux Collections which included the following minerals: calcite, celestite, galena, glaucochroite, hardystonite, willemite, and zincite. Crystallographic measurements of the glaucochroite, willemite and calcite showed the presence of new forms; while the celestite represents a new occurrence of this mineral.

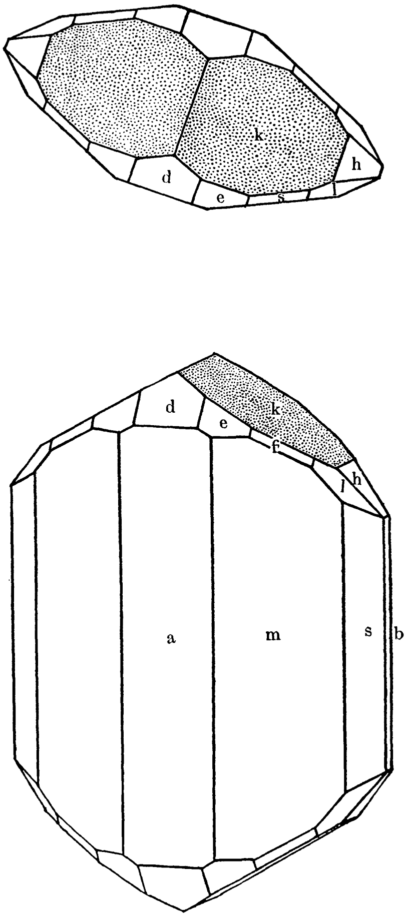

Fig. 1. Glaucochroite, Franklin, N. J.

Glaucochroite

Glaucochroite was described by Penfield and Warren[1] in 1899. The original specimens consisted of small prismatic crystals in nasonite. As no terminal planes were found, the twin-plane (011) was used in calculating the axial ratios. Subsequently Palache[2] described briefly the results of measurements on two terminated crystals.

The specimens which formed the basis of the present study are far superior to those which have been heretofore found. Several large masses of franklinite-willemite ore contain fractures lined with small glaucochroite crystals associated with greenish-white crystals of willemite. The glaucochroite is readily identified by the remarkable fact that the mineral is bluish-green by daylight, but pink by artificial light. The largest crystals measure 2 mm. in length.

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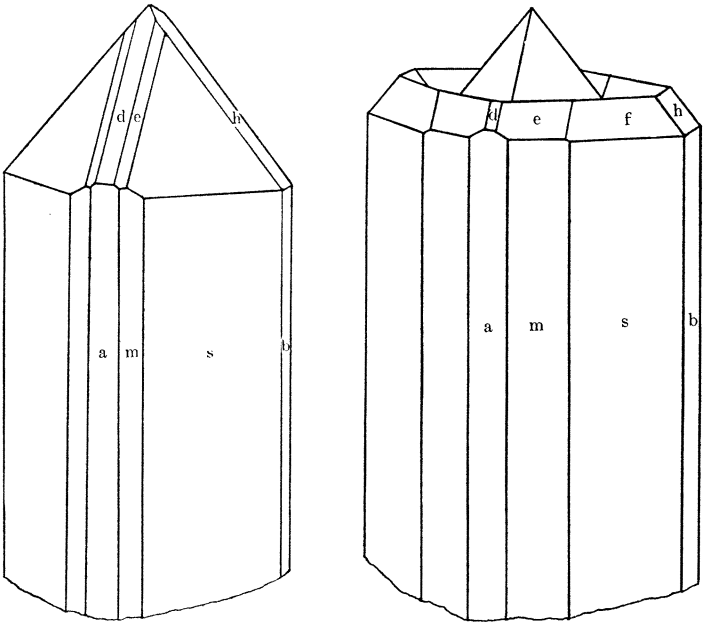
[1] Am. J. Sci. 8, 343–346, 1899.
[2] Am. J. Sci. 29, 181–182, 1910.

Four crystals were measured the results being given in Table I. Six forms are new: r (130), z (270), d (101), k (011), l (131,) and y (122). The relative development of the faces and their position are shown in figures 1 to 4.



Figs. 2–3. Glaucochroite, Franklin, N. J.

Three types of crystals occur; these will be designated below as Types I, II, and III (figs. 1, 2, and 3, respectively).

Type I (figure 1) is of rare occurrence, being limited to the smaller cavities where the conditions were most favorable to perfect growth The crystals show a well-developed prismatic zone, in which there may be an oscillation of a (100), and m (110); terminated by a large, dull, and apparently etched dome, k (011); about which is a prominent zone including d (101), e (111), f (121), and l (131).

Type II (figure 2) shows also a well-developed prismatic zone but the dominant terminal form is the pyramid f (121); h (021) and b (010) show some oscillation, giving raise to characteristic striations on the latter form. This type shows great irregularities, due to parallel growth with other individuals.

Type III (figure 3) was seen on some microscopic mounts. The tops of the crystals show a small crater with a jagged edge; the inner faces of which are irregular, and apparently curved. Ensconced in the crater is a small pyramid, probably f (121). The form b (011) is horizontally striated.

The polar elements, p_o and q_o were calculated from the average angles of the forms d (101), h (021), e (111), f (121), l (131), m (110) and s (120). The axial ratios were obtained from these values. The results are not concordant with those of Penfield and Palache:

TABLE I. ANGLE TABLE OF GLAUCOCHROITE

$a : b : c = 0.4606 : 1 : 0.5899$
$p_0 = 1.2806; q_0 = 0.5899$

Letter	Symbol Miller	Symbol Gds.	No. of faces	Measured φ	Measured ρ	Calculated φ	Calculated ρ
				° ′ ′	° ′ ′	° ′	° ′
b	(010)	0∞	7	00 00± 4	90 00±10	00 00	90 00
a	(100)	∞0	8	90 02± 7	89 54± 6	90 00	90 00
m	(110)	∞	15	65 13±11	89 57± 6	65 16	90 00
s	(120)	∞2	13	47 18±19	90 04± 7	47 21	90 00
*r	(130)	∞3	3	36 28±51	89 39±26	35 53	90 00
*z	(270)	∞$\frac{7}{2}$	1	32 12	90 16	31 49	90 00
*d	(101)	10	5	90 03± 6	51 55± 7	90 00	52 01
x	(103)	$\frac{1}{3}$0				90 00	23 07
*k	(011)	01	2	00 18±16	30 22± 6	00 00	30 32
h	(021)	02	4	00 03± 5	49 56± 5	00 00	49 43
e	(111)	1	12	65 14±39	54 44±24	65 16	54 39
f	(121)	12	6	47 19± 6	60 12±14	47 21	60 08
*l	(131)	13	3	35 52± 7	65 23± 6	35 53	65 24
*y	(122)	$\frac{1}{2}$1	1	47 04	41 02	47 21	41 02

New forms marked *

a : b : c = 0.440 : 1 : 0.566 (Penfield)
.4409 : 1 : .5808 (Palache)
.4606 : 1 : .5899 (Gordon)

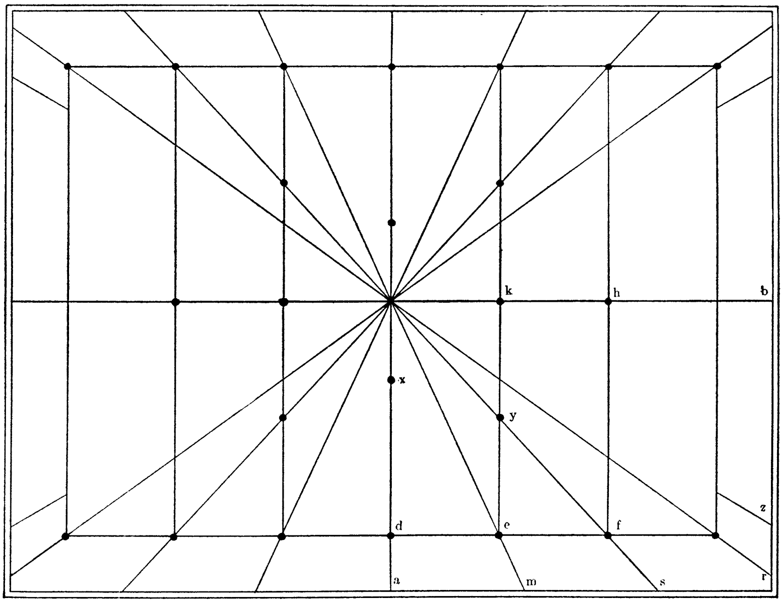


Fig. 4. Gnomonic projection of glaucochroite forms.

The last value approaches that of tephroite, as shown in the following table, in which all the members of the Olivine group are listed in the order of increasing length of the a–axis:

Monticellite	$CaMgSiO_4$	a : b : c = 0.4337 : 1 : 0.5758
Fayalite	Fe_2SiO_4	.4584 : 1 : 0.5793
Tephroite	Mn_2SiO_4	.4600 : 1 : 0.5939
Glaucochroite	$CaMnSiO_4$	.4606 : 1 : 0.5899
Forsterite	Mg_2SiO_4	.4648 : 1 : 0.5857
Olivine	$(Mg,Fe)_2SiO_4$	.4658 : 1 : 0.5865

The refractive indices of one of the crystals measured were higher than *n* 1.740, so that the present mineral is probably intermediate in composition between glaucochroite and tephroite.

WILLEMITE

One of the specimens obtained consisted essentially of franklinite and willemite on which was a cavity containing a number of brilliant, greenish, transparent, highly modified crystals of willemite associated with glaucochroite. A single crystal, ½ × 1 mm. was measured. The general habit of the crystals is indicated in

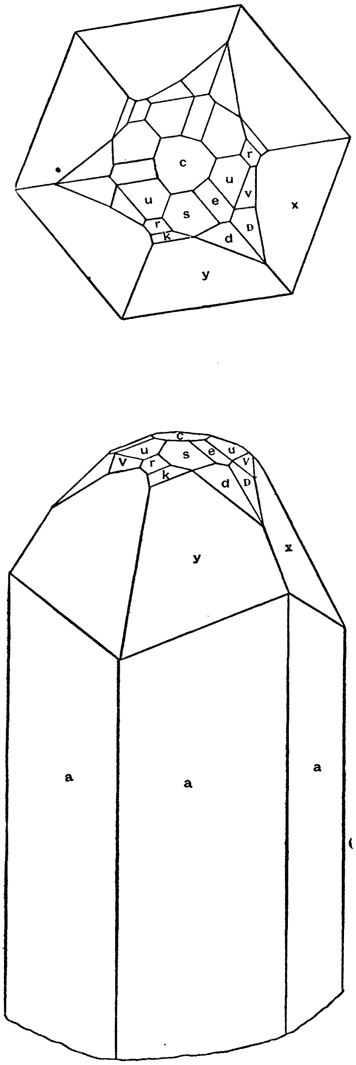


Fig. 5. Willemite, Franklin, N. J.

figure 1. Several of the forms are new: v $(4\bar{2}\bar{2}3)$, K $(31\bar{4}2)$; $(9.1.\bar{10}.0)$, and $(10.\bar{1}.\bar{9}.0)$; v and K were present as prominent faces, although v occurred but once on the crystal measured; the other two forms were represented by line faces in the prism zone.

TABLE II. WILLEMITE, FRANKLIN, N. J.

c = .6679; p_0 = .4453 (Palache and Graham)

Letter	Symbol		Faces measured	Measured		Calculated	
	G2	Bravais		φ	ρ	φ	ρ
				° ′	° ′	° ′	° ′
c	0	(0001)	1			00 00	00 00
a	∞0	$(11\bar{2}0)$	6		89 57	00 00	90 00
*	8∞ (l)	$(9.1.\overline{10}.0)$	2	-35 08	90 00	-35 22	90 00
*	8∞ (r)	$(10.\bar{1}.\bar{9}.0)$	1	-24 59	90 00	-24 47	90 00
e	$-\frac{1}{2}$	$(01\bar{1}2)$	2	29 59	21 01	30 00	21 05
u	10(l)	$(2\bar{1}\bar{1}3)$	2	00 02	24 01	00 00	24 00
s	01(r)	$(11\bar{2}3)$	2	60 05	23 54	60 00	24 00
r	+1	$(10\bar{1}1)$	3	00 04	37 35	30 00	37 39
v*	20 (l)	$(4\bar{2}\bar{2}3)$	1	00 02	41 45	00 00	41 40
d	$-2\frac{1}{2}$ (l)	$(12\bar{3}2)$	3	49 04	45 32	49 06	45 34
D	$-2\frac{1}{2}$(r)	$(1\bar{3}\bar{2}2)$	2	10 50	45 36	10 54	45 34
K*	$+\frac{5}{2}$1(r)	$(31\bar{4}2)$	2	-16 08	54 11	-16 06	54 17
x	+41 (l)	$(3\bar{1}\bar{2}1)$	3	-10 51	63 49	-10 54	63 53
y	+41 (r)	$(21\bar{3}1)$	3	-49 03	63 52	-49 06	63 53

New forms marked *

CELESTITE

While appreciating the greatness of Franklin, N. J., as a mineral locality, and the extreme variety of minerals that have been dis-

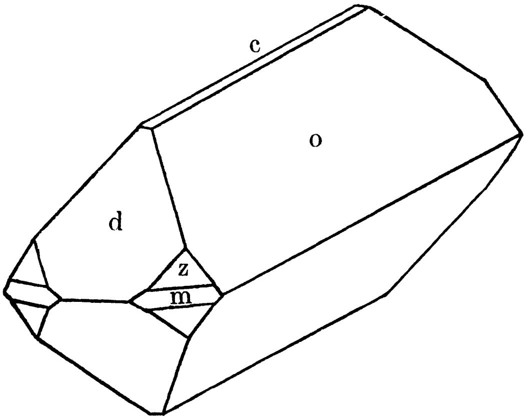


Fig. 6. Celestite, Franklin, N. J

covered there, it was still with considerable surprise to the writer that the material described here proved to be celestite, $SrSO_4$.

The specimen consists of part of a vein of pink rhodochrosite on a mass of calcite through which is disseminated much franklinite. The rhodochrosite, which is quite crystalline, is filled with solution cavities which are coated with druses of brilliant colorless crystals, rarely over 1 mm. in size. The mineral was found to be biaxial, positive; $\alpha = 1.621$, $\beta = 1.625$, $\gamma = 1.631$; all ± .003. A single crystal was measured with the results given in Table III. The habit of the crystal measured is shown in fig. 2; other crystals were tabular parallel to c (001).

TABLE III. CELESTITE, FRANKLIN, N. J.

Letter	Symbol		Faces measured	Measured		Calculated	
	Gds.	Miller		φ	ρ	φ	ρ
				° ′	° ′	° ′	° ′
c	0	(001)	1			00 00	00 00
m	∞	(110)	2	52 03	90 00	52 00	90 00
z	1	(111)	2	52 04	64 18	52 00	64 22
o	01	(011)	4	00 07	51 55	00 00	52 04
d	½0	(102)	2	90 00	39 28	90 00	39 23

CALCITE

The calcite occurs as a cavity lining on a calcite-zincite mixture

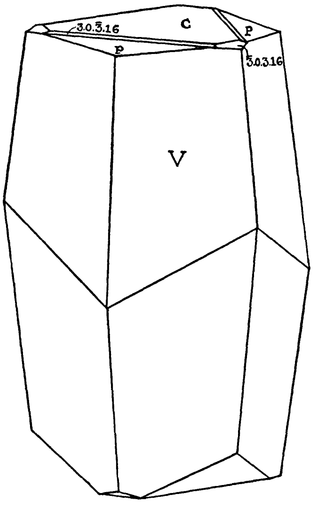


Fig. 7. Calcite, Franklin, N. J.

which forms laminations in an ore consisting of franklinite and reddish serpentine. The crystals are rarely over 1 × 3 mm. in size; but are colorless and give good reflections. The habit of of the crystals is indicated in figure 7. Two forms are new: $(3.0.\bar{3}.16)$ and $(\bar{3}.0.3.16)$.

TABLE IV. CALCITE, FRANKLIN, N. J.

Letter	Symbol		Faces measured	Measured		Calculated	
	Gds.	Bravais		φ	ρ	φ	ρ
				° ′	° ′	° ′	° ′
c	0	0001	2			00 00	00 00
*	$+\frac{3}{16}$	$3.0.\bar{3}.16$	6	30 05	10 32± 7′	30 00	10 29
*	$-\frac{3}{16}$	$\bar{3}.0.3.16$	3	30 06	10 24±12′	30 00	10 29
p	+1	$10\bar{1}1$	6	30 02	44 34	30 00	44 36
V	+16.1	$6.5.\bar{1}\bar{1}.1$	12	3 02	83 53	3 00	83 56

New forms marked *